Wireless E−Learning and Communication Environment: WELCOME at the University of Regensburg

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Abstract. This paper outlines the components of a mobile education system and lists selected examples of universities employing m−education. Several possible approaches in designing and installing such a system are discussed. The main focus is on the project WELCOME (Wireless E−Learning and Communication Environment) at the University of Regensburg. We argue that mobile/electronic education should not attempt to replace traditional education with tutors and instructors but support both student and teacher by providing services that facilitate teaching, learning and education−related administrative tasks. The basic approach is integrative, combining a variety of devices (mobile and non−mobile) via a variety of transmitting techniques (wired and wireless).

1 Introduction − Can Learning and Student Services be Improved by Handheld Devices?

With the new paradigm “anytime, anywhere computing” a shift from “electronic” to “mobile” services has begun. So as e−commerce is extended to m−commerce, e−learning now includes m−learning. The benefits of the newly gained mobility are expected to be reflected in more efficient education and improved learning results. M−learning is the next step in the evolution of e−learning.

Consequently after successfully implementing an e−learning sytems at the University of Regensburg similar progress is intended in the field of mobile education. The bottom−up−strategy in combination with empirical studies of learning success shall guarantee a sustainable development as well as the integration of pedagogical experience in the changing world of learning environments.

The current educational situation is dissatisfactory and mobile education might be able to remedy the problems. One argument that aims specifically for Personal Digital Assistants (PDA) as the device of choice to equip students with is cost [6]. Although prices range from $100 to $800, devices at the lower end of the scale already bring capabilites that are sufficient to provide the basis for mobile learning. Equipped with small educational applications these PDAs can be given out to a number of students, thus providing a higher coverage by giving many students access to a computing device (see [6], p. 20). Other arguments include an increased mobility in todays society, motivational effects due to self controlled learning and better use of spare time − the last two arguments also apply to e−learning in general.

The structure of our paper is as follows. The first part deals with the state−of−the−art and clarifies some terminology. After this a brief survey of mobile education projects is given. The main part describes goals, architecture, functionality, current use and future developments of the WELCOME−system at the University of Regensburg. Finally, based upon this background, preconditions and general recommendations for a successful implementation of mobile education systems are developed.

2 From E−Learning to M−Learning − Concepts and Definition of Terms

We define mobile education as *"any service or facility that supplies a learner with general electronic information and educational content that aids in the acquisition of knowledge regardless of location and time".*

This definition covers a variety of aspects. First, any service which fits this definition can be part of M−Education. Included are supplementary services like passing out devices to students or building a wireless infrastructure. Second, the definition focuses on electronic information/content. Therefore, a student learning at the cafeteria with a printed script is by itself mobile (independent of time and location), but not a subject to mobile education. Note that it is not necessary that the service in itself provides learning content − services that reduce the learners need for secondary information (like due dates, deadlines, dates for additional lectures, the menu of the cafeteria and even the schedules for public transport) help the education by reducing time and effort normally spent on acquiring this kind of knowledge.

The type of device which can be used for a service is basically unrestricted as long as it is wireless. However, wireless does not mean that a constant connection to a server or network is required. A PDA that holds lecture notes which were transmitted during synchronisation using a personal computer and a cradle is a wireless device just as are a mobile phone with a Wireless Application Protocol (WAP) browser or a PDA with a Wireless Local Area Network (WLAN) connection.

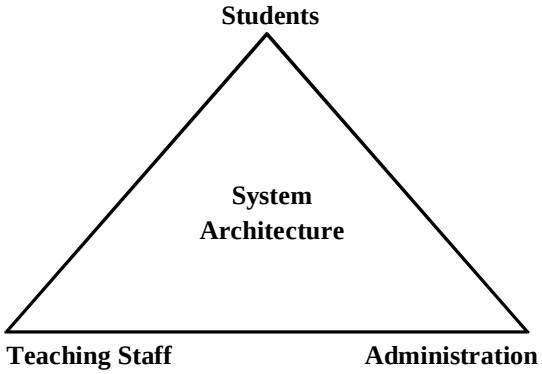

Figure 1. Mobile education system structure

Figure 1 depicts the general structure on relationships between main user groups as a triangle. Because of the rather broad definition of mobile education, there is a wide range of services which can be part of mobile education. In order to classify the services, we split the general field of mobile education into four categories. The following sections discuss each sub−field and the applicable type of services.

Mobile Education is the first category. It is one of the central factors and contains services which are specifically designed to assist the active knowledge acquisition by the learner. A prime example are lecture notes adapted for mobile usage and applications that allow efficient and arbitrary access to them. Two of the key benefits of mobile learning are 'anytime anywhere learning' and 'learning while doing'. Since a learner can carry all

needed content with him at all times (’anywhere’), he is able to learn whenever he finds the time (’anytime’). This could even be outside the classroom, where the learner can depend on the device to supply additional information if needed, but without being central to the knowledge acquisition (’while doing’). Furthermore, the student is in a specific context at that time − which on the one hand makes it easier for him to put the content delivered into perspective. On the other hand, content creation is made easier since the creator can assume a set of certain attributes regarding the learner.

Whilst the most important m−education services are communication and teaching support while outside the classroom, other services supporting teaching activities are relevant too. Specifically the generation of content and administrative tasks are most likely handled inside the teachers office at the personal computer. Although these activi−ties are not dependent on a wireless device, they are still part of m−education since the result becomes part of the mobile education system. Therefore, the system should be integrative, enabling the non−mobile teacher to produce content for the mobile student easily and effortlessly. Usability is the most important factor in this area. The acceptance of a mobile education system depends on the usability as well as on the content delivered (which translates into utility for the user), but without ease of use it will be hard to persuade teachers to create and publish content. Failure to ensure this would thus automatically result in lower utility for the students.

Teamwork between students is increasingly important. Due to the modularisation of courses students from different faculties and with different schedules need to work together. Co−ordination and delegation of work, meetings and practical exercises is not easy, especially if it concerns more than four team members from different disciplines. Mobile technologies can generate new opportunities here. For one, functionality to syn−chronise team members’ appointments and schedules can reduce the problem of finding an appropriate date for meetings where a sufficient number of members can participate. In addition to this, members of a workgroup can utilise locating technologies so they can find out where the other members are and which members are in the vicinity − ultimately contacting them for an ad−hoc meeting. But also the exchange, co−operative editing and distribution of documents is part of the services for mobile workgroups.

Campus Services form the second category. Applications in this category deliver non−educational content. Instead they focus on providing information that help stream−lining the daily routine of the student.

Communication and personal features are the third category. They are particular of interest since small screens limit the means of presenting information. In order to give the student as much information as possible (although not too much) it is sensible to use per−sonalization. Then the student can select by himself which type of information is valuable to him. Communication is also important for workgroups and teacher/student exchange. All mobile devices provide at least one type of communication (e.g. mobile phone allows for phone calls, PDAs can send e−mails), the system should try to provide as many communication facilities as possible.

Study Administration is the fourth category. This includes any action influencing the student’s progress**.** Applications may start a workflow and need a link to back−end systems, depending on the software support in the administration. Major benefits in this area are the opportunity for immediate response by either student or administration and the possible cost reduction as a result of better and quicker information distribution as well as the avoidance of hardcopy printouts/letters. Since this category touches sensitive personal data special attention must be paid to security. Lack of security may not only lead to loss of confidence in the system but could also have legal consequences.

Furthermore, data integrity is a concern. A mobile administration application needs read (possibly write) access to examination information like results or participants. Device−inherent limitations might cause problems for data transactions which need to be considered (see [1]).

3 Survey of Existing Solutions

There are already several systems for mobile education in use, primarily developed and used by universities. The following paragraphs will highlight a few of these systems. Any of these systems focuses on a particular application area. The "Wireless Andrew" project is about building an infrastructure whereas the "pocket−WI" project targets the creation and dissemination of content for lectures. We have chosen these solutions due to their innovative character and to depict the diversity of approaches in implementing a mobile learning solution.

3.1 Wireless Andrew

Wireless Andrew [11] started in 1994 as a research network at the Carnegie Mellon University. In co−operation with Lucent Technologies about 400 WLAN access points were installed on campus to provide optimal coverage for all of the 1700 users. In 2000 the network was update to provide connectivity to all 32 academic/administrative buildings and key outdoor areas. Classrooms and other location with a high density of users have more access points installed so that every student receives ample bandwith.

Initially designed for use with PCs and laptops, an initiative called "Handheld Andrew" [10] connects PDAs and subnotebooks with the wireless network and tries to create a sizeable userbase utilising these smaller devices. The project team has programmed three applications for the most common tasks: mobile electronic mail, calendar management and event notification. All applications focus on improving workflow and communication in groups. While Carnegie Mellon provides and maintains the network, it does not provide free hardware for the students − although the necessary equipment can be bought at an on−campus store with a substantial discount.

3.2 pocket−WI

In January 2001 the chair for new media at the Technical University of Vienna introduced "pocket−WI" [15], an AvantGo−channel [8] containing content for three courses. Students may subscribe to this channel for free. The channel had to be designed much like a small, barren website while the AvantGo software acts as a minibrowser.

Since AvantGo checks, downloads and compiles the website when the user conducts a synchronisation (also possible via a modem), the student can use the documents off−line without the need for a wired classroom. In addition to this, the costs for the student and the institution are much lower because there is no need for special equipment or infrastructure nor a lengthy period of connection to the network. It should be noted however that AvantGo charges a yearly fee [7] for providing a channel which is depended on the number of subscribed users and starts at $1000.

3.3 Consolidated High School District 230, Illinois − Schools of Thought

Students in all three Consolidated High School District [12] 230 schools in Orland Park, Ill. In the USA, are participating in the largest educational deployment of handheld computers in the United States. Nearly 1,700 students and 65 teachers are taking part in

the program. District 230 began its technology planning in December of 1995. The first two years allowed the District to get its technology up to acceptable standards. Instead of lugging a laptop to class or trooping to the computer lab, students are carrying their computer in the palms of their hand. After a semester of successfully incorporating the devices into class lessons, the school district plans to expand the program

3.4 Berlin University of the Arts (HdK)

The Campus−Mobil® project [9] managed by Condat AG addresses students and staff of Berlin's Technical University (TU), of the University of Applied Sciences (TFH) and of the Berlin University of the Arts (HdK). Supported by the project partners, they are to discover, develop and test mobile communication services. With free mobile phones provided by Siemens and special rates offered by the T−Mobile International AG for the duration of the project, the participants can make phone calls and send and receive SMS via WAP using either the Global System for Mobile Telecommunications (GSM) or General Packet Radio Service (GPRS). The three universities and the further project partners berlin.de and ZLB (Berlin Central and Regional Library) customize information according to the students' personal profiles and locations. This information originating from different data sources and formats is transmitted to the the users' WAP−phone dis−plays via Condat's specially developed portal server. Skyware®, a special Mobile Middleware developed by Condat, allows to customize content to the user's individual needs and offers assistance for orientation. The Skyware Portal® enables the access of mobile devices to different data sources and formats. The flexible technical platform integrates a WAP− and SMS−gateway. Having an open architecture, Skyware® allows to easily adapt new services and devices to the system.

4 Goals and Functionality of the WELCOME−System

4.1 General Goals and System Requirements

While all of the projects described in chapter 3 are early and foremost in this field, the WELCOME project at the University of Regensburg represents a more integrative approach. It has been built upon existing experiences and solutions in the field of e−learning [2] [4]. The planned mobile and wireless system shall support both teachers and students in an innovative way. The internet−based e−learning platform VUR (Virtual University Regensburg) is meanwhile widely accepted and broadly used. It serves as a fundamental software architecture for all wireless learning and administrative services. Selected features such as news, distribution of learning materials and personalization are already available for mobile devices.

4.2 Technical Infrastructure and Systems Architecture

The University of Regensburg has built an extensive IEEE 802.11b wireless network which facilitated the creation of mobile education services. It consists of 13 access point covering the most frequented areas. We are currently making an effort to lend mobile devices with WLAN access to a group of students − these kind of devices are not common amongst students whereas mobile phones are. This not only brings the number of users closer towards a critical mass but also enables us to carry out valid empirical studies regarding mobile education. The results of these studies will then be the basis for future developments.

Besides providing access via WLAN we also offer (plan to offer, respectively) access using technologies like WAP, Short Message Service (SMS), AvantGo or VoiceXML. Table 1 shows what we believe will be the most likely type of connection used in a given situation. We think that a wired connection using a PC or a laptop is always preferrable due to ease of use and speed, although it is only available at the students home and in a computer room. A WLAN is only available at the facility, whereas WAP, SMS and voice−technologies are more widely available (within the service providers area of network coverage which might rule out rooms inside a building) − but even though WAP might be available, users are likely to choose different access technologies due to lower cost or higher speed. Therefore we do not believe that WAP is a feasible (although technically possible) alternative when being at home or in a classroom.

Table 1. Situation/likely connection

	Wired	**WLAN**	**Sync**	**WAP**	**SMS**	**Voice**
at home	X		X		X	
en route			X	X	X	X
at facility		X	X	X	X	X
in classroom		X	X		X	
during breaks		X	X	X	X	
in computer room	X	X	X		X	
in workgroup		X	X	X	X	

Table 2 outlines the basic advantages and disadvantages associated with each type of connection from a students perspective. While wired and WLAN connections are generally faster and provide more capabilities they are not always available and require special equipment (PC or WLAN adapter card) which is costly. Synchronising PDAs ('Syncing') is a good way to have information available anywhere at low cost, but the timeliness is a drawback since the data is only updated when the user commits the synchronisation. All in all, however, the advantages outweigh the disadvantages so syncing is a technology that should be considered when designing m−educational services.

WAP, SMS and voice connections provide up−to−date information but can be costly and the amount of information transmitted can vary. A SMS is limited to 160 characters (although the future developments Enhanced Message Service [EMS] and Multimedia Message Service [MMS] are not) and WAP pages should be less than 1400 octets in size [14] to assure general operability. Mobile phones on the other hand are common among students so it is a device well known to them.

Another important point in the development of mobile services was the observance of the usability aspect. Therefore we have created a catalogue of criteria [3] beforehand of which the user interface of the system is based upon.

Table 2. Advantages/disadvantages of connections

	Wired	WLAN	Sync	WAP	SMS	Voice
timeliness	+	+	−	+	~	+
availability	−	−	+	~	~	~
cost	+	~	+	−	~	~
transfer speed	+	+	+	−	~	~
equipment needed	+	−	+	~	+	+
reliability	+	+	+	−	+	~
security	+	~	+	~	+	+
capability	+	+	~	~	−	−

+ has advantage
− is at a disadvantage
~ neither adv./disadv.

Regarding security it is important to say that the unrestricted admittance is only possible with a valid user identity of the University of Regensburg, which is automatically given to all students, assistant professors and lecturers by the computer centre (there exists a guest−admittance with restricted contents). Adequate security is insured by encrypting all data with SSL3 at 128 bit. For the mobile admittance the user has to enter a PIN, because the level of security here depends on the transmission technologies of the carrier and is not within our zone of control. When the infrastructure supports Wireless Identification Module (WIM) [13] additional security can be established by unambiguosly identifying a user.

Figure 2 shows the information architecture of WELCOME. All relevant information is put into one of the two databases. One contains all educational content, the second contains all additional data which could be of interest in a mobile environment. The educational content database is part of the framework for the VUR (Virtuelle Universität Regensburg), which is described in detail in [4].

It is an educational environment designed to give every student the chance to get online access to tele−teaching−programs without complications and without any special computer−knowledge. But also the lecturer who offers courses and teaching material via this portal should be able to do this simpler and easier than up to now. For this reason not only a platform for presenting courses and lectures (learning environment) but also administration functions have been integrated which enable the lecturers to upload supporting texts and teaching materials as well as to change or to cancel them.

For every course teaching materials of different kinds are made available online. The range comprises simple scripts or lecture notes (e.g. in PDF) as well as complete virtual lectures consisting of interactive hypermedia documents or video and foil presentations. The entire contents are being generated dynamically from the data base.

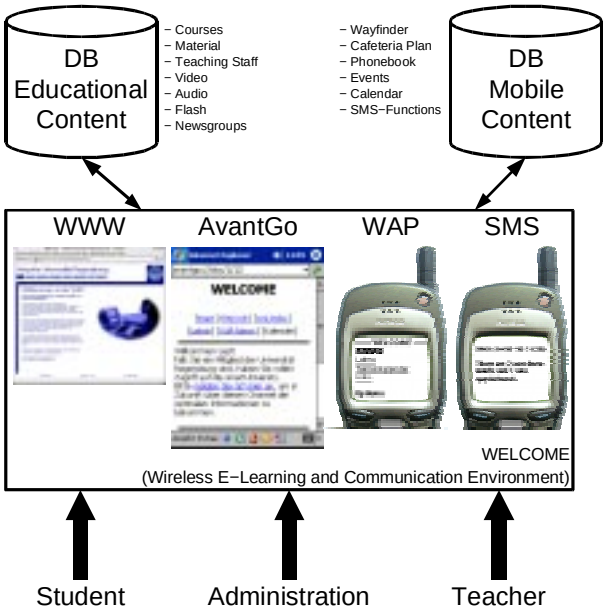

Figure 2. WELCOME system structure

As a consequence the actuality of the visible information is guarenteed at all times. In contrast to other countries this requires a more differentiated selection of employable tools, because the telephone charges in Germany are much higher than, say, in the USA. All educational aids can be browsed online by the learner or downloaded on his local computer. As a result there is the possibility to study online or offline. After careful optimization and appropriate selection of hard− and software it could be achieved that even virtual lectures with videostream and foil presentations from home via an ordinary telephone line could be recalled in pretty good quality and without sound distortions. An important goal when designing the system was the support of all kinds and different means of communication (synchronous as well as asynchronous).

Therefore the standard−internet−services like e−mail and newsgroups have been integrated as well as a comprehensive chat−system which consequently offers the opportunity of moderated virtual consulting hours and online−discussions.

4.3 Features and Functions

WELCOME currently consists of several services as shown in figure 3. Italicized items are still under development.

Mobile education services provide access on materials. To remain platform independent PDFs, RealVideo and −Audio streams as well as Flash animations are used. Table 3 shows what kind of media can be shown on the different devices, though it is not imperative to make use of all available media. The cost−benefit relation of a learning material presented with a specific medium as well as the technical equipment and qualification of the content−producer is of importance for the decision whether to utilize certain media or to revert to another medium.

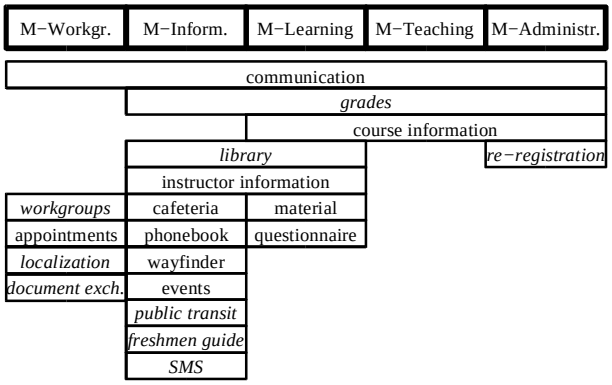

Figure 3. Categories and services

The content in the area of mobile is mostly generated by parsing 3rd party websites such as the Cafeteria page, the Internal Telephone Directory and the Events Calendar. Users on a PC can use these sites directly without any problems, whereas mobile users mut resort to WELCOME as a translator for these pages since they can not access this information directly. For them WELCOME converts and compiles the content and then presents it adapted for mobile devices.

All of the media listed in table 3 are used in WELCOME. Current devices differ to a great extend in their media reproduction (voice, video, graphics, text, ...). With a steady development of hardware and operating systems this will be improved.

With the help of the offered media a student can retrieve lecture notes or query for their availability. This makes it possible to learn outside class, with learning not being restricted to re−reading notes but also testing the matter using self−control questions. Moreover, the mobile device in this case is an efficient substitute for paper based materials.

Table 3. Multimedia device capabilities

Medium	**PDA** **PocketPC**	**PDA** **PalmOS**	**Smart** **Nokia C.**	**Handy**
PDF	X	X		
Videostream			X	
Audiostream	(X)		(X)	(X)
Video (dl)	X		(X)	
Audio (dl)	X		(X)	
Flash	X			

X supported
(X) supported but with limitations (e.g. additional commercial software)
(dl) downloadable medium, can be viewed offline

Besides accessing media a student may get contact information of the lecturer (see figure 4), for example: consultation hours, telephone numbers (with the possibility to initiate a phone call), room number (linked to the wayfinder) and e−mail adress (allowing to send a mail directly). All this information is linked to the respective information/communication service.

Campus services contain a cafeteria plan, a pathfinder (see figure 5), an event calendar (see figure 6) and a telephone directory. They are transferred from the website of the university or students administration, then evaluated, converted and stored in a database.

Figure 4. WAP screenshots of WELCOME

The pathfinder and time table are developments not reverting to the WWW. With the first one a user can enter his location and his aim by typing in a designation of a room nearby or by using certain keywords (like ’cafeteria’, ’restroom’ or ’library’). It is also possible to define an aim by a lecturer’s name. Should an entry be ambiguos the system asks for clarification presenting a menu with all known choices that fit the general description. If the aim is unclear, the shortest way to that type of location is shown.

Figure 5. The pathfinder of WELCOME

Figure 6. Page with current events

The time planner keeps the events, lecture hours and all the appointments concerning a department/institute/ chair or a workgroup. This tool approves coordination. To avoid interface problems a client for PalmOS is being developed. This client then directly transfers the relevant information from the server based application to the PDAs application database.

Furthermore **communication services** can be used for peer to peer contacts between students as well as group communication. In the future a freshman's guide will be introduced. This guide provides help and checklists for all situations a beginning student might encounter. Notifications and information on new material will be provided via SMS or similar messaging services. Students will also be able to look up the schedules of the public transit system or exchange documents within a workgroup.

4.4 Current Use and Future Enhancements

By February 2002 the user base consists of about 400 persons, approximately 10% of them being lecturers (professors, assistant professor and assistants). In the winter semester 2002/03 a bigger jump is to be expected, because the larger part of the freshmen will be much more open minded about new technologies. One can assume that the critical mass is about to be reached here. The next step will be the attempt to stimulate enough people to use one of the mobile education services.

5 Conclusion

5.1 Requirements for Implementation

In order to successfully install a mobile education system several premises have to be met. If this does not happen to be the case, the system will not automatically fail but the acceptance will be somewhat lower and might not justify the monetary and personnel costs involved. On the other hand it might be sensible to develop a solution before the need arises due to the fact that most of the factors are constantly changing.

1. At least one technical **promoter** and one promoter in power must actively support the system. The role of the technical promoter is to demonstrate repeatedly the abilities of the system and therefore its usefulness. His position should be strengthened by a person in charge so any suggestions and explanations from the technical promoter cannot be fended off as unnecessary or irrelevant. It should be noted that students can act as a promoter in power by repeatedly asking the teacher to make use of the mobile education system.
2. While designing the system the **requirements** of all persons concerned should be taken into account. This premise guarantees increased acceptance by all users, espe−cially if they were actively involved during the design. Rejection after the im−plementation can thus not be justified with shortcomings of the system since these could have been pointed out at an earlier stage.
3. All users should be assured that their **competence** will not be diminished. While this premise has a business background (meaning that employees will not suffer from negative consequences if a new system is established in their firm) it still holds true in some regard for teachers and administration. It should be pointed out to them that they will not be replaced by the system but that it will help them with their work and that everyone will gain from it.
4. An **infrastructure** must be in place. This includes the availability of mobile devices, since some of these devices are not cheap − especially when taking the generally limited budget of a student into account. It is possible to design services that can be used without any special hardware. For example in Europe mobile phones are common among students and current phones support technologies like WAP and SMS − using those obviates the need to equip students with a costly PDA.
   Building the infrastructure creates expenses, although it depends on the kind of infrastructure who has to carry the cost. If opting for a WLAN, the institution has to pay high initial costs for the installation of access points (about $1000 each) so the campus has adequate coverage. Then very little expenses are incurred during operation. The same is true for the students who need to purchase a WLAN−card (about $200) resulting in high initial but little operational costs.
   Using an already existing infrastructure creates very little cost for the institution, this is the case when services are available via the students mobile phone: here the infrastructure of the service provider transmits the information. Looking up information with WAP results in costs for the student, SMS based push−services on the other hand result in expenses for the institution.
   Infrastructure most certainly includes software, workstations and server for hosting, maintenance and creation of mobile services as well, though it is very likely that such an infrastructure is already in place.
5. The services need to meet **usability requirements**. Using the system should be as easy as possible. The definition of usability of the ISO is "... a measure of the

effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in a particular environment ...". So the system should not only work but work well.

Usability on mobile devices is a particular problem as described in [3] although the kind of usage must be taken into account. In general the content preparation and pub−lication done by the teacher will still take place at a non−mobile PC using well known and familiar tools. Mobile devices will then request and display the content. In addition to this they might be used to enter data (e.g. taking notes, answering questionnaires) or to communicate with other students while outside the classroom. More complex tasks (writing an essay for example) require more powerful devices like a laptop where usability is no longer a salient problem.

6. To ensure constant usage of the mobile education system **stability** has to be guaranteed. First, stability in a technical sense means that services should perform within nominal parameters regarding speed and availability. This becomes a primary issue when the link to a mobile device is slow. Instability in this case, like lost connections and dying applications, will most likely render any previous and not saved or stored input made by the student useless.

   Second, stability also means an appropriate design and layout of the graphical user interface. Current mobile devices have limited display size and cumbersome input methods so navigation can be streamlined by using a simple and uncluttered layout that emphasises on making frequent tasks unproblematic.

   Third, stability includes a constant supply of relevant content. If the system is working flawlessly but there is no interesting information provided the users will lose interest in the system. This is in part the responsibility of the promoter in power (see above) who can exercise positive and negative sanctions in order to assure that content is provided.

   Last, stability is about maintenance. Errors in programming can never be completely ruled out, so there needs to be a contact point where someone responsible can receive bug reports and suggestions which then should be incorporated into the system to assure continued acceptance. Again, this links to a premise already mentioned: taking the need of the users into account.
7. The system needs to be **secure**. The necessity and the level of security hinge on the data processed in the mobile education system. Documents for lectures and other educational content could be secured in a way that only authorised users − students, teachers and staff − have access to them. This might be desirable from a teachers point of view when the documents should not be widely distributed because they contain confidential information or simply because it is the teacher's wish.
8. There is an increased need for **privacy** of data. This is tightly linked to security. If data about students are to be processed the level of security should match the sensi−bility of the data with names needing low security, personal information (like address, phone number etc.) needing higher security and secret information (like grades, exams, test results, additional remarks etc.) requiring highest security and most access restrictions. The more data is kept by the system, the better it can adopt to the needs and requirements of the user.

   Enhanced privacy and security furthermore result in added trust in the system. This should in turn increase usage and acceptance whereas low security will almost cer−tainly have detrimental effects.

   Mobile devices can help privacy and security issues since they are regarded as personal devices which a user carries with him most of the time. Thus a device can be

specifically linked to a single user. Moreover, wireless connections can be encrypted. It is basically possible to eavesdrop mobile transmissions although this requires exceptional effort.

5.2 Assessment

All in all it can be said that with today's technologies mobile education is basically possible to implement, but such a system will have to deal with several restrictions. While the distribution of general information and educational content is easier using wireless technologies device capabilites currently limit the possibilities of presenting them. In the future new devices are to be expected so the m−learning services will resemble todays e−learning solutions.

As of today, WELCOME is a valuable addition for the students compiling regularly needed information in one solution in the palm of your hand. Usage is currently a bit low but is expected to increase once we put cheap and simple methods of access (specifically SMS) to use and mobile devices are becoming widespread. Also we expect that implementing services desired by students will boost the number of users. It is currently not feasable to analyze and evaluate the effect of mobile learning, but it is planned to conduct an empirical study to assess the benefits (and possible shortcomings) of the system.

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